Lab’s fuel cell knowledge tapped for surveys of catalyst technology

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Two recent articles in *Advanced Materials* leverage Los Alamos’s extensive expertise in fuel cell technology. The articles, one by Los Alamos researchers and another with their external colleagues, survey current developments in precious-metal-free electrocatalysts and progress in understanding the main causes of their instability.

The Laboratory’s role in developing fuel cells and hydrogen as an energy source goes back more than 40 years to when DOE awarded the first Fuel Cells for Transportation program to the Lab. Los Alamos continues as a core laboratory for the DOE Fuel Cell program—leading two DOE-awarded multi-lab consortia, which are focused on fuel cell performance and technology improvements.

Development of alternative energy sources is crucial to tackling the challenges encountered by the growing global energy demand. Hydrogen fuel holds promise as it can be efficiently converted into electrical energy via direct electrochemical conversion in fuel cells, releasing water as the sole byproduct. However, the current technology’s reliance on expensive platinum-group-metal (PGM) electrocatalysts has impeded its use.

Remarkable progress has been made in PGM-free catalysts. Synthesized from inexpensive, earth-abundant, and easily sourced materials, these catalysts are more than 200 times more cost-efficient than precious-metal based materials and are approaching their performance. However, the limited durability of PGM-free catalysts has hindered their widespread adoption.

In “Progress in the development of Fe-based PGM-free electrocatalysts for the oxygen reduction reaction,” the Los Alamos authors reviewed the current state of the technology. They concluded that further improvements will require a controlled synthesis of materials with high reaction activity and overcome catalyst degradation. The research was featured on the journal’s August issue cover, which featured an image by co-author Xi Yin.

In “PGM-free cathode catalysts for PEM fuel cells: a mini-review on stability challenges,” Piotr Zelenay and his external colleagues noted that demetalation and carbon oxidation

are the most likely degradation mechanisms affecting PGM-free catalysts. They call for a standard test protocol to allow unambiguous comparison between a variety of PMG-free catalysts.

The work, funded by the DOE Office of Energy Efficiency and Renewable Energy, Fuel Cell Technologies Office, supports the Laboratory's Energy Security mission and its Materials for the Future science pillar by investigating new materials for alternative energy conversion systems.

References:

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"PGM-free cathode catalysts for PEM fuel cells: a mini-review on stability challenges," by Yuyan Shao (Pacific Northwest National Laboratory), Jean-Pol Dodelet (INRS-Energy Materials and Telecommunication), Gang Wu (University at Buffalo), and Piotr Zelenay (Materials Synthesis and Integrated Devices group), *Advanced Materials* 31, 1807615 **(**2019).